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XXXV.—*Observations on the Habits of a Tenthredo or Saw-fly.* By PIERRE HUBER*.

[With a Plate.]

THE insect which is the subject of this memoir is, I conclude, somewhat rare in our country [Geneva], as I have not yet observed it except in the larva state; and these larvæ are so uncommon, that in looking diligently for them, I have scarcely found more than one or two every year. My design is to make known the first period of its history, looking for the time when more favourable circumstances may enable me to complete it. I especially regret my inability to give the description of the perfect insect; but, as we know with respect to a great number of insects, all the philosophic interest attaches to the history of the larvæ. It is these indeed which most frequently exhibit to our sight that industry which so justly excites our admiration.

This insect belongs to that division of the Saw-flies (*Tenthredinidæ*), the larvæ of which, not furnished with membranous feet (prolegs), have only six coriaceous feet belonging to the thorax, and whose hind part or abdomen is armed laterally with two hard and horny processes which diverge from one another nearly in a straight line. These very prominent processes, I believe, are attached to the last ring but one. The last ring did not appear to have organs like the anal prolegs of caterpillars; it is, on the contrary, of a coriaceous and solid substance, variegated with a brown colour above; it terminates in an oval margin, and opens upwards in order to serve as a passage for the rejectamenta of the insect; but in some cases it also performs the office of a foot. The head is wholly coriaceous, its eyes are very distinct and prominent; it is furnished with strong and rather short jaws, with two antennæ placed near the eyes, and with two or three pairs of palpi, the length of which exceeds that of the jaws, and which serve the purpose

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of a hand for holding the leaf upon which the insect is feeding or working. The length of this larva varies from six to eight lines, it is half a line thick; its ordinary colour is bluish green, the head is yellowish, and the feet are black; there is a small black spot on the first ring. In its first stage this insect lives upon the hazel-tree.

Most larvæ of *Tineæ* and other insects expert in forming for themselves cases (*fourreaux*) carry them about with them, but (during the early period of its life at least) the larva in question is obliged to leave its case fixed to the leaf out of which it has been formed; it therefore preserves all the verdure of the leaf itself; at last, however, comes the time when this larva separates the case from the leaf and carries it from place to place. The case in which it envelopes itself is of a very singular form; it is a very much lengthened hollow cone, very narrow at the end with a rather wide mouth; it is made of a strip or band of a hazel-leaf rolled in a spiral form and composed of a number of variable whorls; this strip, very narrow at the lower extremity, at first produces only very narrow whorls and of small diameter, for at first the larva wants but a very narrow case. When complete it is from twelve to fourteen lines in length, and two lines in diameter at its orifice; it is composed of more than ten turns, the exterior part of the case presenting the upper surface of the leaf, the serrated edge of which is preserved entire, turned towards the point of the cone. This dwelling is very spacious for our larva, and it can turn itself about in it with the greatest ease.

It forms this cone by cutting along the edge of the leaf a narrow strip, which it then winds spirally around itself by a method which I shall presently describe. When this portion has taken the desired form or position, it goes on cutting the band a little further up, and always nearly parallel with the edge of the leaf. By little and little it rolls around itself a fresh portion, and so on during all the time of its growth; so that the cone, which was at first very short, lengthens every time that the larva works at it. But it is not content with clothing itself; it feeds as it goes on, it even eats prodigiously; only, while eating, it takes good care to attend to the arrangement of the strip or band necessary for its clothing; it eats according to method, and with the double object of providing itself at once with board and lodging; I say lodging, for this case, being too roomy to be justly considered as a mere garment, serves it rather as an asylum than as a defence against the inclemency of the weather.

Another part of the skill of this insect consists in knowing how to roll this bandage round itself, which unsupported would

fall by its own weight like a shred of the leaf. It will be supposed that it is by means of its silk, skilfully employed, that it succeeds in giving it the requisite position and fixing it in its place.

I shall give a full description of the method which it practises, a process in some degree analogous to that of the rolling caterpillars, which consists in carrying threads from the surface of the rolled portion to that part of the leaf which they wish to join to their work. The weight of their body, resting on the first threads, brings the leaf near to the centre of the roll, and fresh threads tend to keep it in this position. But the manner in which our larva works every time that a fresh portion of leaf is to be added to his case deserves greater detail.

There are generally three skeins. or wefts* stretched from the mouth of its case to the leaf. The first weft or skein is situated on the body of the case; this is the shortest, and reaches the leaf by the shortest course; the second proceeds from the middle of the last whorl and also goes to the leaf; and the third is fastened on still higher up, that is to say, at the point where the rolling of the band begins. These wefts are composed of threads parallel to each other, and nearly perpendicular to the orifice. After the larva has bitten the leaf so far as to separate enough for rolling up, it comes half out of its case, mounts on the first weft and produces a fresh one which I shall call No. 1 *bis*, similar, except that the threads are fixed higher on the roll and on the leaf. After this operation it re-enters its funnel, and comes out again at the space which lies between the second and the third older wefts; it mounts upon the second, makes it bend with its weight, or perhaps by the contraction of its body, and establishes a weft No. 2 *bis*, composed of a score of silk threads; lastly it places itself on the third, and from thence makes a new weft No. 3 *bis*. By this means the work of rolling up goes on in succession, and the whole portion cut off is rolled up at once, the spiral cone acquiring a quarter of a whorl at each time; it gains each day a complete whorl. In fact, it is the cone which is rolled successively on the bandage. Now the three wefts *bis* become fundamental, and serve as types for three new wefts, which in their turn will be succeeded by others. Such is the tenor of this process so far as I have been able to ascertain. The roll turns during the operation of fixing the threads, and not at all while the larva cuts out the bandage. We should mention

* A row of parallel threads is obviously intended. The word *trame* of the original has been rendered *weft*, with some doubt however of its being the proper term.—R. T.

that the rolling caterpillars make cylinders with leaves, whereas in the present case the rolling up must be oblique in order to produce a spiral, and this, probably, is what renders necessary the complex process which the larva of the Saw-fly of the hazel employs.

The axis of the cone or case of our larva is frequently placed at right angles to the tangent which might be drawn at the edge of the leaf; yet the orifice is not parallel to this edge; on the contrary, this opening is very oblique, and such as it should be in order that the band of which it is formed in rolling up may only cover over the last spiral by its edge, so as to form a prolongation of the case, and not a simple coating.

It sometimes happens that this larva, whether by chance or by design, detaches its case from the leaf: this especially occurs when the leaf withers; for then it is obliged to seek for a fresher one, a thing which frequently happened to those which I had under my observation at home. I have often amused myself by cutting the little bands and suspending the case underneath the leaf, by means of some one of the scattered silks which remained at the mouth, as the larva itself does when its case is wholly finished. But I operated before the time, and it had still several whorls to add to its cone: had I left but a single thread, it would have been sufficient to bring back its case towards the leaf, for this larva, of a slender form, is gifted with an unequalled agility and suppleness. Coming more than three-fourths out of its cone, it bent itself in a thousand ways, and by its skill succeeded in reaching the leaf, to which it fastened some imperceptible threads of silk; it clung to these threads, then drawing its body forwards, it made the case approach the leaf by help of the side legs and the two processes near its hinder extremity; then bound it with new and shorter threads of silk, so that it nearly touched the lower surface of the leaf.

The cone had now to be made to travel in this situation. The process which it employs is most ingenious: it leans forward out of its case on the side to which it intends to direct it; and, as far as it can reach, stretches threads of silk from the leaf to the case. This latter, held back by former threads, does not as yet move at all; but the caterpillar, with its accustomed ingenuity, cuts the former threads with its jaws; if they resist too much, it stretches its body so as to force away the cone, when the last attachments break: in this way the cone is suspended only by the new threads, its centre of gravity is now displaced and is carried forward. A fresh similar manœuvre effects a new step; thus travels this heavy load, sustained by threads of silk which are substituted for each other

in succession. Our traveller at last arrives at the end of its journey, that is to say, at the end of the leaf. It then brings its case near its under surface, and adjusts it or places it in such a way as to be situated in the plane of the leaf; but on the outside he sets it up as sailors raise a mast on its base, only so as to be placed horizontally in the air, and that instead of drawing the cords on the side where it wishes to make it fast, it finds the means of establishing shorter and shorter threads of silk, and bursts the old threads that kept it in a vertical position. It has, in short, the art to lead the spiral tube to the suitable place and into the position requisite for again beginning its rolling up. It cuts off the inequalities and adjusts it so neatly to the edge of the leaf, which is also prepared beforehand for this purpose, that the junction of the two pieces shall be imperceptible. The leaf fits exactly at the edge of the case; threads of silk, carefully stretched within, sew together (if we may so speak) the two parts, and the caterpillar then setting itself to gnaw the leaf, eats it parallel to its edge, so as to give it the dimensions of the bandage of the case.

I shall conclude this notice with the last experiment that I made on one of these larvæ, and the result of which presents some very curious particulars. It was still young, it had composed its case of twelve whorls, and I saw that it had added one or two turns of new ribbon. It was working at it when I took it out in order to lay it bare; I then perceived that the portion of the case newly added being looser than it ought, and consequently the whorl being too wide at this part, the insect had obviated this inconvenience by spinning around itself such a number of threads that they formed a narrow sheath at the orifice of the case.

The larva being exposed, was gently laid upon a fresh and tender hazel-leaf, the underside of the leaf being turned upwards. At first it appeared embarrassed; it tried to turn upon its back, and it was only after many trials and efforts that it succeeded in effecting this; from this time it regained courage, and sought to carry its head from right to left of its body in order to reach the leaf in this position; but the want of a *point d'appui* for a long time hindered it from accomplishing this. However, by dint of twisting itself about, it at last succeeded, placing its spinneret upon the leaf on its right side; by a circular movement of the head, it led a thread from thence to its left side passing above its body; from that time it no longer appeared embarrassed; the movements became quicker and quicker; it had soon made a lace-work of silk above itself, fitting well enough to hold it closely against the leaf, yet without cramping it. By help of these threads it became

easier and easier to raise up the anterior part of its body, and to stretch longer or more oblique threads, at its choice; in order to do this, it bent its body in the form of an arch above the leaf, so as to make supports of all the threads which it had stretched above it. The play and muscular strength of its rings made of all these threads so many ladders, which helped its body to advance on the cordage which it had spread; and the plaited nature of the rings of its belly, and especially the large size of the last ring but one, greatly contributed to the success of its efforts: the motion begins at the tail, it advances, the rings swell and contract successively, they quit the threads to which they correspond in order to rest on other more advanced threads, and the whole body travels two lines in advance. The caterpillar then spreads fresh threads above itself, and by the same process gains a little ground every time; in short, it attains the object of its efforts, being always turned on its back; when it has reached the edge of the leaf it stops. Such is its way of proceeding when naked.

I was very curious to know how it would repair the loss of its covering at an age when the size of its body differs from what it was at first, and when a turn of ribbon two lines in width is not sufficient for it. I had the satisfaction of seeing this work done, which was worthy of some skilful tailor in a desert island who might be obliged to make his own garment. I will explain it in two words: the caterpillar had the tact to make itself a complete covering out of a single fold, which it cut to its measure, after having rolled it around itself. For that purpose, after having made a deep fold in the leaf around itself, it made a hole in the middle of the leaf, enlarged it by degrees, and rolled this wide shred about itself, just as we should draw a covering over us. The covering folded upon itself forms a double envelope, which the insect converts to its use in this position, by sewing it with numerous threads at the two ends.

Nature, as we see, is rich in ingenious expedients: so much originality in the means, so much variety in the processes, so much skill and depth in her views, what do these declare? what do they proclaim,—if not the indisputable, the infinite wisdom of the Creator of all things?

EXPLANATION OF PLATE VI.

Fig. 1. The caterpillar, natural size.

Fig. 2. The same, magnified.

Fig. 3, 4. Different appearances of the rolling-up of the case before the caterpillar forms its threads.

Fig. 5, 6, 7. Various positions of the caterpillars in forming the case by means of their threads.

Fig. 8. The closed case.